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JPRS 84820

25 November 1983

USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 117

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USSR REPORT

Electronics and Electrical Engineering

No. 117

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MEASUREMENT OF PHASE OF COHERENT PULSE SIGNAL IN PRESENCE OF CORRELATED
INTERFERENCE

IVANOV, V.A. and SOKOLOV, G.A.

[Abstract] In problems such as the selection of moving targets it becomes
necessary to measure the phase of a coherent pulse signal in the presence
of correlated rather than uncorrelated background interference. The technique
of such a measurement is considered here from the standpoint of constructing
an optimum algorithm of phase measurement under such conditions. The signal
is assumed to retain its complete coherence throughout the measurement time
and the interference is assumed to include "white" noise in addition to its
correlated component. The mean frequency of the correlated interference
component is zero and intraperiod processing of the signal, with orthogonal
correlators, yields a sequence of complex readings $\dot{y}_k = R_k + jI_k$. The
likelihood function for the phase and the phase relations in the incoming
message are established on this basis. The dependence of the phase estimate
dispersion on the signal frequency normalized to the pulse repetition rate
is calculated for a typical numerical example. Figures 1; references:
3 Russian.
[291-2415]

QUALITY FACTOR AND ENERGY CENTER OF ANTENNAS

POLISHCHUK, I.M.

[Abstract] A quality factor of antennas is introduced in purely electro-dynamic terms and defined as a measure of deviation from the ideal, impossible to realize, field distribution. According to this concept,

$$Q = \min_{\text{var } 0} \left\{ 2\pi \frac{W(E_1, H_1)}{(P_S + P_L)T} \right\}$$

(W- energy, P_S- average over a period radiation power, P_L- average over a period power losses, T- period, E_1, H_1 - deviation from field which satisfies Maxwell equations) and the point where $W(E_1, H_1)$ reaches its minimum is called the energy center. These definitions are applied to antenna arrays of conductors and dielectrics in space, in a spherical system of coordinates. On the basis of this concept, the class R_A of physically realizable radiation patterns F= Ax is narrowed down to those $F \in R_A$ for which this Q-factor has a finite value. The concept is also applicable to other open systems wherever energy is dissipated by a departing wave with an electromagnetic field of infinitely large energy. The author thanks Ya.N. Fel'd for valuable discussions. References 10: 8 Russian, 2 Western.
[291-2415]

SYNTHESIS AND ANALYSIS OF ALGORITHMS OF SPACE-TIME SIGNAL AND INTERFERENCE
PROCESSING WITH FLUCTUATIONS OF WEIGHT FACTORS FOR ANTENNA ARRAYS ACCORDING
TO MARKOV MODEL

RODIMOV, A.P., POPOVSKIY, V.V. and POPOV, A.S.

[Abstract] Algorithms of space-time signal and interference processing by
an antenna array are synthesized. These algorithms essentially include
an estimation of the weight factors vector, and are applicable to the general
statistical case of equations of state which are not necessarily linear.
A standard detectable useful signal is assumed to be available, which places
constraints on the synthesized adaptive antenna array executing such an
algorithm. After processing, the antenna output signal is assumed to appear
with noise which, in the case of optimal processing, constitutes a regenerating
process in the form of an approximately white noise. With the dynamics of
the varying weight factors vector described by a Markov model, namely a
multi-dimensional stochastic differential equation of state, estimates are
made in the quasi-linear approximation with maximum a posteriori probability
as the optimality criterion. Special cases of this general algorithm are
the Widrow-Hoff algorithm and the Baird algorithm, as well as the Rodimov-
Popovskiy-Popov-Dmitriyev algorithm (VOPROSY KIBERNETIKI: TEORIYA
CHUSTVITEL'NOSTI I YEYE PRIMENENIYE [Problems of Cybernetics: Theory of
Sensitivity and Its Application], Izd-vo Nauka, 1981 pp 171-191). The
general algorithm covering any real situation such as radar is now analyzed
for efficiency in terms of noise and interference suppression: ratio of
output signal-to-noise ratio to input signal-to-noise ratio and ratio of
output signal-to-(noise+interference) ratio to input signal-to-(noise+
interference) ratio, considering external interference and isotropic noise.
As the angular separation between signal and interference within the major
lobe increases, it reaches a threshold above which the dependence of the
ratio of signal-to-noise ratios on it becomes strong while the dependence
of the ratio of signal-to-(noise+interference) ratios on it becomes weak.
Figures 5; references 11: 6 Russian, 5 Western (1 in translation).
[291-2415]

GENERALIZED AMBIGUITY (WOODWARD) FUNCTION FOR SIGNALS WITH COMPRESSION DURING
SCATTERING OF WAVES BY BODIES OF INTRICATE SHAPES

GUSAKOVSKIY, V.Ye. and SHTAGER, Ye.A.

[Abstract] Scattering of waves by a body of intricate shape is described
and analyzed by means of a generalized ambiguity (Woodward) function. The

body is regarded as an array of point reflectors rigidly bound together and vibrating as a single entity. The Woodward function has been used for defining the mean level of the output signal from an optimum receiver containing a square-law detector and a matched filter of input signals with a random initial phase. In the case of scattering it can be expressed through the Woodward function and the distribution of the mean effective cross section for scattering in a space of signal time delays and Doppler frequency shifts. The scattering function of the body is expressed through the transient pulse response function of the equivalent linear filter. This expression is simplified by assuming narrow-band input signals, a stationary normally distributed process of changing distances from source to receiver as a random function of time, with differences between distances from point sources much larger than the wavelength, and a scattered signal with an amplitude varying slowly during vibrations of the scatterer and thus proportional to the square root of its cross section for scattering. On this basis, probing signals are considered with linear frequency modulation and a bell-shape envelope, their resolution and compression depending on the signal duration. Calculations reveal that the compression factor and the maximum of the reciprocal indeterminacy function for such signals peak within the medium range of signal duration (10^{-4} - 10^{-3} s), dropping sharply in the ranges of short and long durations. The distance resolution does not depend on the duration of the probing signal in the short-duration range and is proportional to it in the medium-duration range. The velocity resolution is inversely proportional to the duration of the probing signal in the medium-duration range and does not depend on it in the long-duration range. In the short-duration range the distance resolution is determined by the swing of vibrations of the local source. In the long-duration range the velocity resolution is determined by the width of the fluctuation spectrum of the reflected signal. Figures 4; references: 4 Russian.
[298-2415]

CHARACTERISTIC FEATURES OF POLARIZATION-TIME PROCESSING PROCEDURES BASED ON MARKOV FILTRATION THEORY

POPOVSKIY, V.V.

[Abstract] Polarization-time processing procedures are proposed for the non-linear case where the separation theorem does not apply and continuous orthogonalization of the antenna basis with respect to the interference becomes too difficult. The main feature of these procedures is that not the polarization parameters of incoming signals and interference but the optimum weight factors are estimated, with the receiver system consisting of two mutually orthogonal antennas and a common summator designed to ensure minimum mean-square deviation of the incoming signal from the reference

signal. The changing of the two weight factors in time is described by a
stochastic first-order differential equation. From this equation a system of
two differential equations of estimates is derived, one for each weight
factor, and the corresponding a posteriori dispersions are determined
from the solution to three Riccati equations which describe them. Another
feature of these procedures is that these Riccati equations must be solved
in real time, despite the linearity of both the state (input) and the obser-
vation (output), because the a posteriori dispersions depend on the results
of observation (readings). Minimum mean-square signal deviation as the
criterion yields the minimum interference power at the receiver output.
The convergence of these procedures is fast and fits within the correlation
interval. They can also be extended to space-time processing and space-
polarization processing. Their effectiveness is illustrated using the
Poincare sphere for signal and interference, assuming a signal with noise,
and using the Wiener-Hopf matrix equation for the optimum weight factors.
Figures 2; references 5: 3 Russian, 2 Western (in Russian translation).
[298-2415]

EFFECTIVENESS OF ANGULAR DIVERSITY IN AUTOMATIC CONTROL OF DIRECTIVITY OF
SHORT-WAVE RECEIVER ANTENNA

MASLOV, O.N.

[Abstract] Angular diversity of antennas eliminates the need for additional
antennas, but the reception branches generally do not have uniform statis-
tical characteristics. The feasibility of forming reception branches in
this case by means of fanned radiation patterns is examined on the basis of
the theoretical correlation factor in such a system and the results of measure-
ments in an experimental setup. Both general n-fold and conventional two-
fold reception are considered. Experiments were performed with two short-
wave diversity antennas, a 3BS-2 and a 4ABVP, and two receivers in a common
bay. Edge distortions were measured with an IK-3U-1 meter generating error
pulses and transmitting them to a counter. Measurements were made over a
10,000 km long latitudinal transatlantic route in the carrier-telegraphy
mode of signal transmittion at the rate of 100 bits/s at 3 wavelengths
(19, 27, 37.5 m) and with 2 phasings (-45° for the 3BS-2 antenna and +45°
for the 4ABVP antenna). In addition, the author had proposed a scheme for
automatic preselection of radiation patterns. Signals from n antenna outputs
corresponding to different radiation patterns proceed through a controlled
commutator switch to m receivers loaded into a common signal processing
module. A sampling module drives the commutator so that the latter succes-
sively connects to the receivers various combinations of "m out of n" reception
branches. Each connection is analysed and ultimately the one ensuring
maximum effectiveness of diverse reception is selected. The results indicate

that twofold reception with angular diversity is about equally effective with either of the two short-wave antennas and that such a reception not only eliminates the need for additional antennas but also replaces other modes of diversity such as spacing. Figures 7; references: 7 Russian. [295-2415]

EXPERIMENTAL STUDY OF RESONANACE-TYPE ANTENNA SYNTHESIZED ACCORDING TO GIVEN RADIATION PATTERN

KATSENELENBAUM, B.Z., KORSHUNOVA, Ye.N., PANGONIS, L.I. and SIVOV, A.N.

[Abstract] The feasibility of synthesizing a resonance-type antenna according to a given radiation pattern has been demonstrated experimentally. Such an antenna was synthesized by a rigorous method based on the theory of natural oscillations in an infinite space. Practical assumptions included a transmittivity of resonator walls uniformly deviating from ideal around the contour and a level of background hum inversely proportional to the resonator Q-factor. The criticality of the radiation pattern as well as of the resonator Q-factor and natural frequency was not estimated. The radiation pattern of the antenna in the form of an open resonator with $Q \sim 100$ and $f_0 = 9.375$ GHz was to be $O(\phi) = \sin^8 1/2 \, \alpha$. The actual antenna was built as a 200 mm high vertical coaxial cylinder consisting of a solid-metal inner layer and a tubular semitransparent outer layer between two dielectric base rings. The antenna was tested as a receiver antenna. Its frequency characteristic, measured with a standard panoramic instrument, has a sharp peak corresponding to $Q = 94$ about the resonance frequency $f_0 = 9.4$ GHz. Its radiation pattern is very close to the theoretical one, with a width of $67.5°$ at $1/2 P_{max}$ power level. Figures 4; references: 3 Russian [298-2415]

QUEUES IN RADAR SYSTEM

KOVAL'CHUK, I.A.

[Abstract] A radar station with a phased antenna array is considered for tracking several targets with different access periods. A control system is used for storage of data characterizing the period T_i of access to each

of n targets in the i-th group, the total number of targets being $L = \sum_{i=1}^{1} n_i$. A method is proposed for determining the statistical characteristics of a queue in such a system and the constraint is established which limits the throughput capacity of the system in terms of the number of targets it can track. The tracking system is regarded as a queueing system and classified according to the flux of incoming calls, the distribution of attendance time, and the number of attended objects. Two classes of such systems are considered: M/G/1 with an arbitrary distribution of attendance time and with the probability distribution of queue length obtainable from the Polyachek-Chinchin equation, and M/D/1 with a constant attendance time. The statistical characteristics of a queue, specifically the first and second moments of its distribution, are estimated with the aid of the appropriate generating function. In order that a queue have a finite length, according to the theory of queueing systems, it is necessary that the system utilization factor be smaller than unity:

$\tau_m \sum_{i=1}^{1} n_i/T_i < 1$ (τ_m-mean attendance time). This constraint yields the

upper bound on the number of attendable targets. The relation can be modified so as to apply to a radar station with variable attendance time.
References 3: 2 Russian, 1 Western (in Russian translation).
[294-2415]

METHOD OF COHERENT SPACE FILTRATION OF ONE-DIMENSIONAL IMAGE DISTORTIONS
WITH USE OF WHITE LIGHT SOURCE

LAPIDES, A.A.

[Abstract] A method of coherent space filtration of one-dimensional image
distortions is proposed which does not require preliminary coding of the image,
the pulse response to one-dimensional distortion being a function of only
one Cartesian coordinate. The basic feature of this method is use of a
white light source, the image being illuminated through a narrow slit, a
light filter, and a widening objective. The source is placed at the focus
of the objective on the z-axis so that the light leaves the latter in the
z-direction toward the image as a beam of constant width in the y-direction
of the source (slit) orientation and of increasing width in the transverse
x-direction. The image, in the (xy)-plane with a transmittance amplitude
distribution e(x,y), is oriented with the distortion running in the
x-direction perpendicular to the slit. Another objective behind the image
performs a spatial Fourier transformation and forms the image spectrum in
the Fourier plane. The correctness of this method is demonstrated by
mathematical analysis of the sequence of events in the case of a plane
wave obliquely impinging on the distorted image. The method has been
proved out experimentally in filtering the line structure of a television
image with a white light source highly coherent in both the x and y
directions. Advantages of this method are its energy efficiency and low
cost, as well as absence of coherent spottiness noise. The author thanks
M.Ye. Zhabotinskiy, A.V. Furduyev and A.I. Shpuntov for helpful discussions.
Figures 4; references 11: 3 Russian, 8 Western (4 in translation).
[291-2415]

METHOD OF DETERMINING AMPLITUDE-FREQUENCY CHARACTERISTICS OF REGULAR MULTIMODE FIBER OPTICS

KORSHUNOV, I.P. and MATVEYEV, R.F.

[Abstract] For inspection purposes, the amplitude-frequency characteristics of regular and irregular multimode fiber optics are usually determined either from the Fourier transform of the pulse response or from direct measurement of the transmission coefficient over a wide range of light-carrier modulation frequencies. A simpler method is proposed for regular multimode fiber optics (no coupling between modes) which involves measurement of the transmission coefficient at a fixed modulation frequency but with varying fiber length. In an experimental setup for this method a He-Ne laser beam passes through a quarter-wavelength plate, an electrooptical harmonic modulator, and an analyzer. A light splitter mirror then divides it between the measuring channel (microobjective - fiber - focusing objective) and the reference channel (two 45° reflecting mirrors). The two beams are combined by a light comparator mirror and sent to a photoreceiver (optical traveling-wave tube) not simultaneously but alternately. The correctness of this method is demonstrated by mathematical analysis of the light field at fiber entrance and exit. The method was tried experimentally on a fiber with a gradiental profile of the refractive index and an initial (maximum) length of 42 m. The laser beam was modulated by a $LiNbO_3$ crystal at a frequency of 7 GHz (25-30% modulation at peak modulator power of 7 W) and an F-LBV optical traveling-wave tube with maximum intrinsic noise of 10^{-13} W/Hz served as photoreceiver. The results, converted to a base length of 1 km, agree closely with calculations based on field correlation analysis for an 800 m length of the same fiber. Advantages of this method are its usefulness for factory inspection during extrusion of fiber and that it does not require wideband modulation and detection. The authors thank P.O. Shevchenko for assisting with measurements and V.V. Grigor'yants for supplying specimens of glass fibers as well as for helpful discussions. Figures 2; references 12: 7 Russian, 5 Western (1 in translation).
[291-2415]

TRANSIENT PROCESSES IN DIGITAL PHASE LOCKING BY 'SPACE OF STATES' METHOD

DEMIN, M.P. and IVANOVA, Ye.B.

[Abstract] A second-order digital phase locking system is considered which contains an analog-to-digital converter in the frequency synthesizer loop. The latter also includes a pulse insertion-or-exclusion device and a counter-divider in series as well as a digital filter for astatization and notching. The exact model of such a system is linearized so as to facilitate an evaluation by analytical rather than numerical methods. With a small tracking phase error, the calculation error is assumed to be arbitrarily small. In the steady state the discretization period is equal to the period of the useful signal. In the transient state the tracking phase error varies, because discretization of the input signal occurs at instants of time not coinciding with its zero crossovers during each period. The transient processes are analyzed by application of the "space of states" method to the corresponding homogeneous difference equation, which has two particular solutions. A comparison with calculations by the approximate quasi-continuous method indicates that the latter method is sufficiently accurate. Figures 3; references 4: 3 Russian, 1 Western.
[294-2415]

IMAGE-CHANNEL SELECTIVITY OF TELEVISION RECEIVERS

BABUK, G.V., LOKSHIN, M.G. and MIKOLAYTIS, I.I.

[Abstract] The selectivity of television receivers in the range of decimeter waves is an important parameter to consider in the planning and laying out of multiprogram television broadcasting networks, an image channel being defined as the frequency band between $f_{i,min} = 2(f_{i.c.} + f_{i.f.}) - f_{max}$ and $f_{i,max} = 2(f_{i.c.} + f_{i.f.}) - f_{min}$ ($f_{i.c.}$ - image carrier frequency, $f_{i.f.}$ - nominal frequency of intermediate image carrier, f_{min} and f_{max} - lower and upper cutoff frequencies of reception channel). The receiver selectivity is determined by mutual interference between television radio transmitters and quality criteria in this respect are, accordingly, based on the acceptable level of interference field intensity. In one extreme case the reception point is closest to an interfering transmitter, in another extreme case both signal and interference come from the same direction so that the interference immunity of the receiver antenna becomes zero. Both cases are analyzed

quantitatively for a typical situation of channels n+8 and n+9 in the field of 20 kW radio transmitters (300 m high antenna support, range of 54 km radius) and 100 W television relays (75 m high antenna, range of 7 km radius). The necessary selectivity of a receiver is calculated on the basis of standard relations and specific data. The results are checked against experimental data on 10 different television receivers, 4 in black-and-white and 6 in color, in order to establish a statistical correlation and channel layout guideline. Figures 5; tables 1; references 9: 3 Russian, 3 Japanese, 3 Western.
[295-2415]

HIGH-GRADE FORMABLE ALKIDE COMPOUND FOR PRODUCTION OF HOLDERS OF ERASING HEADS IN VIDEO RECORDING DEVICES

FRANKE, K., B.V. Lange Voorhout, coworker, BETA Public Relations, The Hague [The Netherlands]

[Abstract] A special-purpose high-grade alkide compound is used for injection molding of holders of erasing heads in "Philips-2000" video recording devices. This compound is produced by Synres Almoco B.V. in Heock (Netherlands). The AMC-2561 thermosetting resin is reinforced with short glass fibers. The material is refractory, both thermally and mechanically very stable, with excellent mechanical and electrical characteristics. It is very suitable for injection molding, filling any cavity without blow holes and sink holes. It also does not stain the mold. Parts made of this material are easily bonded together with epoxy resin and can be machined together with parts made of ferrites or ceramics. Figures 1.
[294-2415]

CIRCUITS AND SYSTEMS

DISTRIBUTION OF NORMAL-MODE CURRENTS IN ARRAYS OF COUPLED MICROSTRIP LINES

IL'INSKIY, A.S. and ZARUBANOV, V.V.

[Abstract] The dielectric loss per unit length and the distribution of sur-
face currents of natural modes have been calculated for symmetric arrays of
microstrip lines consisting of two, three, and four parallel conductors on
a common substrate. The $x = 0$ plane which cuts through all conductors at
half-thickness was assumed to be a plane of symmetry, with boundary condi-
tions of electric wall (odd modes) or magnetic wall (even modes) satisfied
at it. The dispersion equation was derived by the spectral method. Calcu-
lations were made on a BESM-6 high-speed computer. The results reveal that
for a microstrip array of more than two conductors, depending on the geometry
and the electrodynamic parameters, the dispersion curves of different modes
can intersect. As the clearance between conductors is narrowed and the
ratio of conductor width to substrate thickness is decreased, the dielectric
loss becomes lower with odd modes than with even modes. Figures 5; refer-
ences: 2 Russian.
[298-2415]

SYNCHRONOUS FILTER WITH LOW LEVEL OF SWITCHING INTERFERENCE

YEREMENKO, A.I. and MALYAREVSKIY, N.M.

[Abstract] The problem of lowering the interference level in synchronous
filters is considered, one effective method being an inverse connection of
the transistor switches. This reduces the effects of nonideality of the
switches and of the variance of their parameters. The interference level
is then reduced by decreasing the base current. Bipolar transistors, with

low collector capacitance and low open-circuit impedance, are most suitable for this purpose and require lower control voltages than do field-effect transistors or integrated-circuit MOS switches. Bipolar transistors with high forward transfer ratio and low reverse transfer ratio will cause the least interference in the filter, the interference level depending on both collector and emitter capacitances. Series 149 and 198 integrated-circuit filters have better interference characteristics than analogous discrete devices. An extremely simple synchronous filter with an interference level not exceeding 1 mV can be built using an open-collector circuit such as K133LA8, which requires only two transistor-transistor-logic modules. Figures 1; tables 1; references: 4 Russian.
[294-2415]

SYNTHESIS OF PYRAMIDAL STRUCTURE OF DIGITAL FILTER-DEMODULATOR ARRAY

VITYAZEV, V.V.

[Abstract] A pyramidal structure of k digital filters-demodulators in an array of $\log_2 k$ stages for frequency division of channels is synthesized by the method of modified forward convolution, a method particularly suitable for an array with short fall time using filters other than the not always applicable recursive ones. The basic procedure is developed for a single-stage structure of an array with each square-wave demodulator in series with a digital low-pass filter. The algorithm is then extended successively to a two-stage structure and a pyramidal structure of an array. The increase of the volume of calculations per unit time with increasing number of stages is found to be minimizable, although the efficiency of transition from R to R+ 1 stages is somewhat lower than in the ideal case. Figures 3; references 8: 6 Russian, 2 Western (1 in Russian translation).
[295-2415]

FAST SYNTHESIS OF NONRECURSIVE DIGITAL FILTERS WITH CONSTRAINT ON TIME DELAY

TITOV, M.A. and BONDARENKO, N.N.

[Abstract] Synthesis of nonrecursive digital filters involves an evaluation of the convolution $y(n) = \sum_{k=0}^{K-1} h(k)x(n-k)$, which can be done either directly

or by "fast" methods. In the latter case the array of input readings is processed "as a whole," but then storage of this array and calculation of the output cause an inevitable time delay. There are various means available for limiting this time delay, which is necessary in communication equipment. Most effective, in the case of not too large K dimensions, is "fast" convolution on the basis of rectangular transformations. The procedure involves calculation of intermediate sums $[a_j]$ and $[b_j]$ for the array $\{x_j\}$ of length S and the array $\{h_j\}$ of length K, respectively, after both arrays have been extended to sequences of length N. The elementwise products of the intermediate sums are then calculated and, as a result, a sequence $\{m_j\}$ (j= $\overline{1,M}$) is obtained. Summations at the output, describable by an MxN matrix C yield the sequence $\{y_j\}$ with $[y_j] = C[m_j]$. The result of such a cyclic convolution will be equivalent to that of an ordinary linear convolution, if N>K+ S- 1. As an illustration, a filter structure is synthesized by this method for K= 36 and a signal time delay not longer than 3 ms at a discretization period of 125 microsecond. It is demonstrated that the volume of calculation will be minimum when all subfilters in the structure have pulse response characteristics of equal length. Figures 1; tables 1; references: 4 Western (2 in Russian translation).
[294-2415]

TEST SIGNAL FOR RECURSIVE DIGITAL FILTERS

YAVORSKIY, B.I. and DOMBROVSKIY, Z.I.

[Abstract] A stable and simple test signal for identification of digital filters is derived from a sinusoidal signal, after the latter has been converted into a digital one in the form of binary codes representing a sequence of readings. Each k-th element of this sequence is expanded as

$$\{x_i\} = \{\bigoplus_{j=1}^{n} (x_j \odot \gamma_j)\} k$$

($\bigoplus$ - summation to modulo 2, $\odot$ - digitwise logic AND operation, $x_j \in GF(2)$- digital factor, $\gamma_j = \theta^{j-1}$, θ- root of primitive polynomial θ, $\gamma_j \in GF(2^n)$ of n-th degree irreducible above the GF(2) field). A digital filter does not require complete exactness so that closure can be achieved by rounding or truncating the results of operations. The necessary equipment then consists only of multipliers, adders, and storage elements for time delay. A sequence for a typical signal such as $X(1+ \sin 2\pi \frac{f}{f_d})$ (f_d- discretization frequency) with $\frac{f}{f_d} = 16$ is shown to be a sequence of rectangular pulses with corresponding porosity. Figures 2; references 6: 2 Russian, 4 Western (all in Russian translation).
[294-2415]

ESTIMATION OF PARAMETERS OF FUNCTION DESCRIBING PHASE DISTRIBUTION IN
RADIO SIGNAL

KARPOV, A.F.

[Abstract] The probabilistic model of phase distribution in a fluctuating
narrow-band Rice radio signal, the sum of a stable component and normal
fluctuations, is to be matched with an experimental lot of sample phase
readings taken at one instant of time each. The method of moments is not
very practical here, even with the use of asymptotic approximations, because
of unwieldy expressions for the mathematical expectation of a distribution
function of general form. It can, however, be modified into a two-step esti-
mation method. A histogram of samples is used for rough estimation in the
first step and deviations are then sampled for fine estimation in the second
step, such a transformation through centering of the initial lot being equiva-
lent to reducing the phase of the stable signal component to zero. Another
algorithm is that based on the maximum-likelihood principle and more rigorous
quality criteria, which makes it more accurate and thus preferable for this
particular application. Figures 5; references: 3 Russian.
[294-2415]

INSTRUMENT DEMODULATOR OF CARRIER TELEGRAPHY AND TWO-TONE CARRIER
TELEGRAPHY SIGNALS

POLYAKOV, L.A. and GALKIN, N.P.

[Abstract] A demodulator for measuring distortions of telegraph signals is
proposed for use in carrier telegraph and two-tone carrier telegraph networks

operating in accordance with relevant GOvernment STandards. Each half-period of the input signal at the instantaneous frequency is analyzed in this demodulator after having been divided into four zones. A pulse shaper, a null detector built with an operational amplifier, converts a sinusoidal signal into rectangular pulses, positive and negative half-periods of the signal being analyzed separately. Zero-crossovers are timed by two slope discriminators, pulses with positive slope trigger a set of one-shot multi-vibrators which generate pulses of fixed but different durations each. Pulses with negative slope trigger similarly another set of three one-shot multi-vibrators combined with inverters and coincidence circuits. The multi-vibrator pulses corresponding to respective code frequencies are damped, and channels in a two-tone carrier system are separated, by means of 4-input OR gates and two RS output triggers. The duration of demodulated telegraph signals is subject to distortions caused by changes from the frequency of one multivibrator to that of another at certain instants of time, which imposes constraints on multivibrator instability relative to the width of zones in a signal half-period. During demodulation of frequency-keyed signals a fractionalization of the message can occur, because of limited channel bandwidth necessary for avoidance of extraneous inputs. This can be prevented by means of a special device consisting of two slope discriminators (0/1 and 1/0) followed by two AND gates to two one-shot multivibrators and two other AND gates on the output side. This device in turn introduces some distortion of signal duration, which imposes stringent requirements on the identicality and stability of its two multivibrators. Figures 6; references: 3 Russian. [295-2415]

LASER-TYPE COMPOUND SCANNER FOR TRANSMISSION OF FACSIMILE IMAGES

GALUYEV, S.V., ROZOV, B.S. and SORIN, L.A.

[Abstract] A laser-type optico-mechanical 2-coordinate scanner has been developed for transmission of facsimile images with a resolution of 10^4x10^4 points in a 600x420 mm^2 frame (effective area 560x380 mm^2) and at a rate of up to 10^3 points/s, the absolute error not exceeding 10 micrometers. Its basic components are a single mirror with an electromagnetic drive mounted in a universal joint for independent movement along two coordinates, two Michelson differential interferometers, an additional deflector acting as symbol (script) generator, and digital-analog control of scanning trajectory and velocity. The laser beam is modulated before the additional deflector sends it through a short-focus lens and a high-power objective to the main mirror, which spaces the generated symbols on the frame according to a given program. Applications for this scanner are limited because of its slowness. It takes up to but not exceeding 2 minutes to fill a frame and several hours to complete one newspaper column. Figures 2; references: 2 Russian. [295-2415]

OPTIMAL RECEPTION OF DISCRETE MESSAGES APPEARING WITH BACKGROUND PULSE AND
FLUCTUATION INTERFERENCE IN CHANNEL WITH VARIABLE PARAMETERS

CHESNOKOV, M.N.

[Abstract] The problem of optimal reception is considered with regard to
binary discrete messages appearing with background pulse and fluctuation
interference in a channel with variable parameters. An optimum algorithm
is constructed on the basis of the theory of conditional Markov processes,
using also the theory of nonlinear optimal filtration of discrete-continuous
Markov processes with continuous space of states. The fluctuation inter-
ference is assumed to be Gaussian with known statistical characteristics.
The pulse interference represents the response of the radio channel before
the resolver to a random sequence of pulses appearing at random instants
of time with random amplitudes and with random durations much shorter than
the duration of an informative message element. At the output of that radio
channel this pulse interference is, in turn, represented as a linear combina-
tion of components of a nondiffusional Markov process. The corresponding
equations and transfer functions yield conditional estimates and cumulants.
The algorithm is efficient at any ratio of signal parameters and inter-
ference parameters correlation time to the duration of an informative message
element. As an illustration, the algorithm is applied to reception of opposite
signals with white noise and with pulse interference in the form of a Poisson
sequence of decaying radio pulses with an exponential envelope. Figures 2;
references: 7 Russian.
[294-2415]

RESULTS OF TELEGRAM TRAFFIC SURVEY IN GENERAL-PURPOSE TELEGRAPH NETWORK

TULUPOV, A.I., PARIKOZHKA, I.A. and TARNOPOL'SKIY, I.L.

[Abstract] The telegram traffic in the nationwide general-purpose telegraph
network has been surveyed every 4 years, the last time in August 1979, the
results being evaluated for the purpose of design and service improvement.
The outgoing flux of telegrams and its processing were quantitatively analyzed
with a complete breakdown into service zones and categories, an important
factor being the trend of changes since the previous surveys. The total flux
handled by the network consists of three components: 1) telegrams coming
from urban branches and regional junctions connected into channel switching

stations of a PS (direct hookup) network; 2) telegrams coming from urban branches and regional junctions connected into telegraph junctions of an ATOL (+ Liman and KS) network; and 3) telegrams coming from subscribers. Statistical data thus acquired on the flow and the processing of telegrams from the originating complex through transit lines to the receiving complex have made it possible to locate and remove deficiencies, to adjust the equipment production and installation, to refine the network design, and to develop and algorithm of service optimization. The next survey is scheduled for 1984. Figures 1; tables 5; references: 1 Russian. [295-2415]

PRIMARY DIGITAL TRANSMISSION SYSTEM IKM-30S FOR RURAL TELEPHONE NETWORKS

BOTVINNIK, Yu.A., POLNER, P.B., VORONTSOV, I.I. and SUKHIKH, Yu.A.

[Abstract] The primary digital transmission system IKM-30S has been designed for operation in rural telephone networks over symmetric single-quad KSPP 1x4x1.2 or 1x4x0.9 cables, in order to make it possible to organize up to 30 subscriber or interstation hookup channels and up to 3 d.c. control signal channels to each telephone channel. It can also be used for organizing a Class 2 broading channel in lieu of 4 telephone channels or for transmission of discrete data and as a 64 kbit/s general alarm channel with standard counterjunctions. The system consists of three separately furnished parts: an analog-digital module, a line channel, and a set of signal channels. The intermediate equipment is an unattended repeater. The system can be used for separating some telephone channels and branching the others in two directions, up to 3 branching points being available in one IKM-30S pulse-code-modulation equipment. Several variants of such an arrangement are possible, typically between one central station and seven points or between terminal stations in a "transverse," "square" or "triangular" pattern. A two-way broading channel is formed by appropriate replacement of individual components in the analog-digital module. Figures 8; tables 1; references: 3 Russian. [295-2415]

ESTIMATION OF OVERLOAD THRESHOLD FOR LINE SEGMENTS AND AMPLIFIERS IN
TRANSMISSION SYSTEMS

KULIKOVA, V.I.

[Abstract] The overload threshold for wideband transistor amplifiers in line
or group segments of transmission systems is estimated on the basis of the
normalized amplitude characteristic of power gain $S(P_{out})$. Measurements are
made with a sinusoidal test signal, but overheating of thermistors in the
automatic gain control presents difficulties which are particularly serious
in the VLT-1920 and K-3600/1020R systems. A pulse method is proposed as
an alternative with the same criteria, namely deviation of the amplitude
characteristic from linearity. Changes in the attenuation of nonlinearity
caused by harmonics up to the fifth order, second and third order being most
significant, in both methods are compared. Both calculations and experiments
have confirmed the expediency of waiving normalization of the gain amplitude
characteristic and using absolute values of nonlinear distortion coefficients
at zero signal power level. Another, the most reliable, method of estimating
the overload threshold is to measure the change in interference immunity of
an amplifier or line segment under a load in the form of a "white noise"
signal (1 dB). Figures 4; tables 2; references 14: 2 Russian, 12 Western.
[295-2415]

INTERFERENCE IMMUNITY OF MESSAGE TRANSMISSION BY MEANS OF WALSH SIGNALS

URYADNIKOV, Yu.F. and STUKALIN, A.G.

[Abstract] Continuous-discrete signals such as Walsh signals with analog
modulation by a message constituting a continuous Markov process is con-
sidered for data transmission. Optimal demodulation of such signals by
various methods is evaluated in comparison with interference immunity and
relative to demodulation of pulse signals. An additive mixture of Walsh
signal and white noise is assumed to appear at the receiver input, any Walsh
signal being defined by known four modulable parameters of which time posi-
tion (phase) and time base (period, frequency) are most practical. An
optimum receiver-demodulator is synthesized and its interference immunity
is estimated for each case according to the theory of nonlinear filtration,
with a sequence of quasi-rectangular pulses approximating the Walsh function.
The results indicate that both modulations are almost equivalent in terms of

receiver performance and that the interference immunity is much higher than with transmission by means of harmonic signals. Even when harmonic signals are made as interference immune as Walsh signals, which is possible in the ultimate version of phase telegraphy, the carrier will not be harmonic any more. Figures 2; references 4: 3 Russian, 1 Western (in Russian translation). [294-2415]

CHARACTERISTICS OF PROGRAMMERS FOR SEARCH OF PULSE SIGNALS

KAZARINOV, Yu.M., MYASNIKOV, V.I. and YURCHENKO, Yu.S.

[Abstract] Digital systems for search of pulse signals consist of a binary quantizer (analog-to-digital converter) followed by a digital storing and threshold device. These systems can be programmed with the aid of a high-speed microcomputer, with either the time of "1" arrivals at the quantizer output recorded in the computer memory or with a shift register at the quantizer output generating "0" and "1" sequences periodically fed to the computer memory. Here, these two methods of data input to the computer memory for programming are evaluated comparatively in terms of the memory capacity required and the number of operations involved. The first method reduces to data sorting, by means of histograms, by successive pairwise merger of data arrays, or by the "bubble" technique. Analysis reveals that histograms or merger of data arrays are more efficient, depending on whether the number of signal periods in n <8 or n $\geq$ 8, respectively, with histograms moreover involving the minimum time delay. In the second method of programming the memory capacity is fixed and does not depend on the number of times the quantizer threshold is exceeded. Most efficient in this case is data processing by digitwise addition of numbers to modulo 2, which requires supplementary arrays in the memory. The first method of search programming is more efficient in the case of many elements of the a priori distance interval and low probability of exceeding the quantizer threshold. Figures 2; references 6: 4 Russian, 2 Western (both in Russian translation). [294-2415]

OPTICAL DIFFERENTIAL-MODULATION CORRELATION METER FOR EXTRACTION OF
LINEAR-FREQUENCY-MODULATION SIGNALS FROM NOISE

SHISHARIN, A.V. and USLUGIN, N.F.

[Abstract] An optical correlation analyzer operating with noncoherent light
is considered for extraction of linear-frequency-modulation signals from
noise. Its dynamic range is shown to be widened by differential modulation
of its output signal, utilizing the dependence of its useful response on
the shift ξ of the signal transparency or image thereof from the reference.
This is achieved by means of high-frequency small-amplitude scanning of that
shift as a function of time, with the scanning amplitude smaller than the
smallest "object" dimensions on the signal recording so that the luminous
flux as a function of the shift $\xi+\Delta\xi$ can be described by a Taylor series in
the small parameter $\Delta\xi(t)$. The response of such a correlation meter to a
linear-frequency-modulation signal is calculated on this basis, considering
that the device operates without square-law detection and without separation
of space of the useful signal from others. The important operation is pro-
cessing the center of a signal, in the case of strongly asymmetric integra-
tion the envelope of the useful response here being the same as in the case
of a modulation correlation meter with phase scanning. The performance of
such a correlation meter with differential modulation was measured in an
experiment with a laboratory prototype of this instrument which consisted
of a split incoherent light source, a biprism, first objective, a modulator,
second objective, reference film, a set of plane-parallel plates, third
objective, a signal transparency, fourth objective (condensing lens), a
photoreceiver (photoelectric converter), a band amplifier, and a recording
device. The results indicate complete absence of interference-causing
analyzer response to the mean level of signal recording. Figures 2;
references: 6 Russian, 1 Western (in Russian translation).
[298-2415]

DEPENDENCE OF CONVERGENCE RATE OF ADAPTIVE TUNING PROCESSES IN INTERFERENCE
COMPENSATION SYSTEMS ON INITIAL APPROXIMATION

ABRAMOVICH, Yu.I. and NEVREV, A.I.

[Abstract] Adaptive tuning of interference compensation systems to a maximum
signal-to-interference ratio by the stochastic method of steepest descent

is considered from the standpoint of gain and efficiency, the object being to reach the necessary compensation level in the minimum number of iterations. The convergence rate of the iteration algorithms in the first stage of the adaptation process is shown to be determined by the form of the initial approximation. The conventional procedure of stipulating the initial approximation matched with the reference vector, the latter coinciding with the optimum solution in the absence of external interference, is found to be expedient also from the standpoint of ensuring maximum speed of these algorithms. This has been confirmed by mathematical modeling on a YeS-1033 computer with full format, allowing calculation errors in the dynamic range to be disregarded. A comparison of the results for the case of two variously spaced interference point-sources, with one initial vector stipulated to be synphasal and another initial vector stipulated to be in quadrature, reveals that deviation from the synphasal solution decreases both the gain in signal-to-(interference+noise) ratio and the efficiency or convergence rate of the adaptive tuning algorithm. Figures 5; references: 2 Russian. [298-2415]

ART OF PROGRAMMING PROGRAMMABLE MICROCALCULATORS, PART 2: COMPILATION OF
OPTIMUM PROGRAMS

TROKHIMENKO, Ya.K. and LYUBICH, F.D.

[Abstract] In a review of the art of solving problems with the aid of micro-
calculators, the authors discuss representations of the algorithms in compact
notation: first in words and formulas, then in programs. Programs 1/34 and
2/21 in the corresponding YaMK (Yazyk MikroKal'kulyatora) languages are
described, including instructions for solving (finding the roots of) the
typical algebraic equation $a_2x^2+a_1x+a_0=0$. The sum of time required for
writing a program and the time required for solving a problem according to
this program serve as the basic criterion of overall microcalculator and
program efficiency. Use of subroutines is considered for calculations with
many input and output data not stored in the memory. Various methods of
optimizing the program and minimizing the necessary memory capacity are
available, normalization and appropriate change of variables being particu-
larly useful in solving differential equations. Others are transformation
of input relations to equivalent simpler ones. There often is a tradeoff
involved between length of microcalculator programming time and length of
problem solving time. The four main guidelines for optimum programming are:
1) selection of fundamental mathematical model; 2) selection and optimiza-
tion of the algorithm; 3) synthesis of algorithm modules with matched integrable
program fragments; and 4) debugging of the program on the microcalculator.
A successful compilation of the optimum program in the output language of a
programmable microcalculator requires complete knowledge of this language
with its semantic, lexical and syntactic characteristics. References: 2 Russian.
[294-2415]

HOLOGRAPHIC EQUIPMENT FOR VISUALIZATION OF SURFACE ACOUSTIC WAVES

GRANKIN, I.M. and KULAYEVA, Ch.G.

[Abstract] A holographic apparatus operating with frequency shift of the
reference wave can be used for visualization of surface acoustic waves,
which is necessary for development and design of SAW devices. The hologram
of a surface acoustic wave is recorded with an object wave of light diffracted
by that surface acoustic wave, this object wave being of the n-th diffraction
order and the reference wave being matched accordingly. The frequency of the
reference wave is shifted by means of an acoustooptic traveling-wave modula-
tor, a frequency converter in which the n-th order space sideband is also the
n-th order time sideband. The equipment for recording and reconstructing a
hologram consists of a laser with a collimator lens which widens the beam so
as to cover the entire SAW device and a second lens which performs the
Fourier transformation, a diaphragm acting as space filter being placed
behind the focal plane of that second lens. The reference wave, of 1-st
diffraction order, is produced in the acoustooptic modulator by the same high-
frequency oscillator which generates the surface acoustic wave. Reflected
by a rotatable mirror, the reference wave forms on a photographic plate a
stable interference pattern with the object wave. A third lens widens the
reference beam and a fourth lens projects the image through a diaphragm
which stops scattered light, for reconstruction of the hologram on
a screen or a photographic film. The equipment was tested on a specimen of
Y-Z cut $LiNbO_3$, with a fan-type interdigital transducer exciting a surface
acoustic wave at a frequency of 80 ± 5 MHz and this wave traveling over a
distance of 12 mm. As light source was used an LG-38 helium-neon laser
($\lambda=0.6328$ micrometer) of 40 W power. The acoustooptic modulator operated in
the Bragg mode. Holograms were recorded on LOI-2 photographic plates with
a resolution of 5000 lines/mm. The equipment can also be used for visuali-
zation of volume acoustic waves and for visualization by the shadow method.
Figures 2; references: 1 Japanese.
[294-2415]

ELECTRON DEVICES

ENERGY MODEL OF IMAGE FORMING PROCESS IN OPTICAL SYSTEM

PON'KIN, V.A. and YUKHNO, P.M.

[Abstract] A model of image formation by an optical system is constructed which rather thoroughly describes the energy relations, applicable to a broad range of propagation medium and optical receiver characteristics. The field in the plane of a real stage is defined as a function of space coordinates and time, the field in the exit aperture of the objective in a medium with random parameters is described by a Fourier transform, and the image forming process in optically conjugate planes is described by an expression for the image intensity. This expression covers the range of spectral photoreceiver sensitivity and can be used as a basis for digital simulation of a large class of optoelectronic devices. A signal buildup time much shorter than the time constant of medium changes and a signal buildup time longer than the period over which the medium does not change are considered as special cases. The finiteness of the photoreceiver dimensions is then taken into account. References 4: 3 Russian, 1 Western (in translation). [291-2415]

NOISE CHARACTERISTICS OF MICROWAVE-SIGNAL PROCESSING DEVICES USING SPACE-CHARGE WAVES IN THIN SEMICONDUCTOR FILMS

GUREVICH, G.L. and KOGAN, A.L.

[Abstract] Microwave thin-film semiconductor devices with traveling space-charge waves are used as amplifiers. Their operation is based on utilizing the distributed effects of space-charge wave buildup and propagation in a nonequilibrium semiconductor structure. These devices are related to GaAs

devices with intervalley electron transfer and it is possible to miniaturize them through application of integrated-circuit technology. The feasibility of using such a device with input electrode and symmetric output electrodes parallel to the ohmic contacts for data processing depends on its noise characteristics. Here the noise factor is evaluated on the basis of the physical processes in the structure and the general transfer function. The results of calculations indicate that such a device can be sufficiently sensitive, its noise factor being nearly as low as that of field-effect transistors with a Schottky barrier. Figures 1; references 7: 3 Russian, 4 Western.
[291-2415]

OPERATION OF GUNN-EFFECT DIODE IN FREQUENCY MULTIPLICATION MODE

ORLOV, V.B. and YAKIMOV, A.V.

[Abstract] The feasibility of operating a Gunn-effect diode as an efficient frequency multiplier is demonstrated on the basis of domain theory. A voltage $u = V_0 + R\cos 2\pi ft$ (V_0- constant bias voltage) is applied to the diode with the frequency of the external alternating field $f \ll f_d$ ($f_d = 1/\tau$, τ- domain transit time) and its amplitude R such that the resultant voltage drops below the domain breakdown threshold V_s, with the domain formation time assumed to be infinitesimally short. The parameters of Gunn-effect current pulses and the spectrum of the diode current are calculated on this basis, the spectrum being a discrete one and consisting of harmonics of the field frequency. The spectral components are those of the sequence of domain quenching pulses (one wide pulse per field period) and those of the sequence of Gunn-effect pulse "packets" (per field period), the spectrum of the former resembling that of a sequence of rectangular video pulses and the spectrum of the latter having a sharp peak at a multiple of the field frequency related to the total number of these pulses per one field period. The results of analysis and calculation indicate the possibility of multiplying a relatively low signal frequency to one falling within the range of Gunn-effect oscillations. The external signal field supplies almost no power for this frequency conversion and its main role is synchronous excitation of the Gunn-effect oscillator operating in the transit mode. The necessary condition for control of current oscillations by the external field is that $R > V_0 - V_s$ with adequate margin and, therefore, the duration of quenching pulse will not be too short. This constraint makes it preferable to excite the oscillator diode with the external field, not directly but through a special pulse shaper. The performance characteristics of such a frequency multiplier, including output power and conversion efficiency, have been calculated and also measured on an experimental prototype. The results suggest its applicability not only to video pulses but also to radio pulses. Figures 2; reference: 6 Russian.
[298-2415]

STABILIZATION OF LIGHT-EMITTING DIODE RADIATION

KON'KOV, V.V., FEDOSEYEVA, O.P. and CHAPNIN, V.A.

[Abstract] The short-term instability of commercial light-emitting diodes such as the AL107B, AL102 and AL307G is 0.12-0.18% per second. The present article suggests a circuit based on operational amplifiers which decreases this instability and allows these devices to be used as the light sources for selection of highly stable light detecting equipment. The circuit operates on the basis of the principle of stabilizing by introducing negative feedback. A fiber optic light guide is used to implement the negative feedback. A second light guide carries the useful radiation flux out of the circuit. The stability of the radiation of the light guides can be increased by this circuit by more than an order of magnitude. Stabilization of the temperature and introduction of a compensating temperature sensitive resistance to the feedback circuit, or transition to pulsed operation in the feedback circuit or the entire circuit to eliminate photosensing diode and operational amplifier dark current drift could increase stability still further. Figures 2; tables 1; references: 6 Russian.
[296-6508]

DOMAIN MODES OF OPERATION OF GUNN-EFFECT DIODE IN ALTERNATING EXTERNAL FIELD

ORLOV, V.B. and YAKIMOV, A.V.

[Abstract] Operation of a Gunn-effect diode in an external microwave field is considered, of interest being transitions from one domain mode to another depending on the relations between parameters of the diode and those of the microwave circuit. The frequency tuning range and characteristic for any given combination of a Gunn-effect diode (fixed length of active region W and concentration of free charge carriers n_0 in it) and a microwave resonator (fixed natural frequency f_r and Q-factor) are fully determined by the constant bias voltage V_0 and amplitude R of the microwave voltage in the resonator, the former being the only independent variable. In the problem of analyzing the diode behavior in an alternating external field, however, the amplitude R and the frequency f of that voltage become independent variables while the diode parameters are selected so as to ensure oscillation in domain modes ($n_0 W > 10^{12}$ cm^{-2}, $n_0/f > 5.10^4$ cm^{-3}s). With a voltage $u = V_0 + R\cos 2\pi f$ applied to the diode, V_t and V_s denoting the domain nucleation threshold and the domain breakdown threshold, respectively, there are three situations possible: 1) $V_0 > V_t$ and $R < V_0 - V_t$, transit mode of oscillation with almost no

change in shape of Gunn-effect current pulses; 2) $V_0-V_t \leq R \leq V_0-V_s$, oscillation with delayed domain formation; 3) $R \geq V_0-V_s$ ($V_0-R \leq V_s$), oscillation with domain quenching possible depending on the ratio f/f_d ($f_d=1/\tau$, τ-domain transit time): a) domain enters anode and new domain forms at cathode, b) domain enters anode but no new domain forms at cathode, c) domain vanishes before reaching anode. For complete analysis and classification of domain modes, including hybrid modes, the V_0, f/f_d, R space is intersected by V_0=const planes so that the various operating modes and their regions of existence can be depicted on coresponding f/f_d-R diagrams. Figures 2; references 6: 2 Russian, 4 Western (1 in Russian translation).
[298-2415]

COMPARISON OF ELECTROPHYSICAL AND FUNDAMENTAL APPROACHES TO MODELING OF
GaAs SCHOTTKY-BARRIER TRANSISTORS

PROKOP'YEV, A.I.

[Abstract] Electrophysical models of GaAs Schottky-barrier transistors are based on three approximations: 1) an assumption that a "smooth" channel allows a one-dimensional formulation of the Poisson equation; 2) an assumption that a sharp boundary between depletion region and conduction region of the active layer facilitates an analytical solution of this equation; and 3) piecewise-linear approximation of the field dependence of the drift velocity, with a sharp transition to a plateau in the high-intensity range, makes it possible to separate the smooth channel segment from the channel segment with velocity saturation within the flat range of the output current-voltage characteristic. None of these assumptions is valid for short devices and a two-dimensional model becomes necessary. Solution of the corresponding Poisson equation for the electron concentration and the resulting distributions of Fermi quasi-level and electrostatic potential are compared with those based on the one-dimensional electrophysical model. The two approach asymptotically as the channel length increases. Another effect of a short channel is a higher cutoff voltage. The agreement between models also improves with longer gates and becomes almost complete with a gate 5-6 times longer than the thickness of the active layer. At the other extreme, the fundamental two-dimensional model becomes inapplicable and statistical models using Monte Carlo methods are required when the gate is significantly shorter than the mean free path for electrons. Figures 2; references 8: 2 Russian, 6 Western.
[294-2415]

EFFICIENCY-OPTIMIZED O-TYPE TRAVELING-WAVE TUBE WITH IRREGULAR RETARDATION
SYSTEM

KURAYEV, A.A. and SOLOVEY, M.P.

[Abstract] Efficiency optimization of an O-type traveling-wave tube with
irregular retardation system is analyzed, considering all factors which
control the interaction process. The one-dimensional nonlinear equations in
the kinematic approximation are refined to include the forces of space
charge. The corresponding boundary-value problem is converted to an optimi-
zation problem, with multiparametric approximation of the control function
by a trigonometric series, with five variable control parameters including
$p = \alpha\omega/v_e = 2\pi\alpha/\lambda_e$ (α- radius of retarding helix) and $\varepsilon = (R_0 I_e e/2\omega^2 m)^{1/3}$, and
with maximization of the wave efficiency η_w at the exit from the inter-
action space through minimization of the inefficiency $1-\eta_w$ according to
Goldfarb and discrete-Fourier-transformation algorithms. The problem was
solved numerically for four values of the ratio b/o (b- radius of electron
beam), namely 0.493, 0.707, 0.8, and 0.98, with $p \approx 1.123$ and $\varepsilon \approx 0.233$ (optimum
values of these parameters in the kinematic approximation). The results
reveal that the forces of space charge do not significantly alter the optimum
values of these two parameters p and ε, but do increase the efficiency some-
what to as high as 81% with $b/\alpha = 0.707$, while they have a defocusing effect
most appreciable near the maximum phase bunching of electrons. Figures 4;
references 7: 6 Russian, 1 Western (in Russian translation).
[298-2415]

SIGNAL DISTORTION IN KLYSTRON AMPLIFIER OPERATING IN TWO-FREQUENCY MODE

GREBNEVA, R.K., ZABALKANSKAYA, E.S. and KLIMENKO, M.I.

[Abstract] Klystron amplifiers are often used for simultaneous amplification
of signals transmitted by two carriers with different frequencies. The
attendant nonlinear conversion of spectra as a result of cross-modulation
causes signal distortion, the level of the conversion products depending on
the nominal klystron power. This dependence was studied in a physical
experiment and in a computer experiment with a 5-cavity klystron having a
rated efficiency of 33% and a maximum tube efficiency of 44%. The equipment
for the physical experiment consisted of two traveling-wave-tube preampli-
fiers, five ferrite-circulator decoupling devices, one phase rectifier, five

attenuators, a commutator switch, an adder bridge, a ripple suppression filter, a directional coupler, a calorimeter with water-cooled load circuit, and electrical meters. Measurements were made with the amplifier input excited at the frequency of one carrier and the input power matched to produce nominal a.c. power in the load. Most interesting were the case of output signals with initially the same power and the case of one signal initially much weaker than the other. The amplitude characteristics were measured at a constant ratio of output signals and with the output power varied from $0.1P_{a.c.,nom}$ to that corresponding to full tube current utilization. The two experiments yielded levels of modulation ripple differing by not more than $\delta B^* = 1.1$ dB in the worst case and carrier cross-suppression levels differing by $\delta M^* = 0.4$ dB at peak tube utilization (below peak utilization the suppression level was comparable with the instrument error and thus could not be correctly compared with computer data). The results indicate that the power rating of a klystron tube necessary for this mode of operation depends on the power ratio of the radio signals and on the desired quality of signal transmission. Figures 2; references: 3 Russian.
[294-2415]

INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

RELAY FOR RAILROAD AUTOMATION AND REMOTE CONTROL

KAPITONENKO, N.G., deputy chief, Leningrad Electrical Engineering Plant, candidate of technical sciences; SUSOYEV, V.N., chief designer; and OFENGEYM Kh.G., deputy chief designer

[Abstract] The Leningrad Electrical Engineering Plant has begun series pro-duction of REL1 (Leningrad Electromagnetic Relay-1), designed for use in railroad automation and remote control systems. The relay has been extensively tested in the laboratory and in operation on the Baltic and October lines. It is now undergoing operational testing on the southern Urals line. It has a number of advantages over previous designs, including high reliability, selectivity of switching, increased service life and vibration resistance, decreased size and weight, decreased consumption of nonferrous metals and silver, an improved plug design and stability of electrical and mechanical parameters. The relay comes in two versions: the REL1 plug version and the BN1 soldered version designed for installation in closed blocks. Photographs and schematic diagrams are presented. The plant is now working on additional models of the new relay design for use in track circuits, power circuits, emergency and other devices. The new relays will be widely used in railroad automation and remote control systems. Figures 3, tables 2.
[297-6508]

NEW STANDARDIZED AUTOMATIC BLOCKING SYSTEM WITH CONTINUOUS 25 Hz RAIL CIRCUITS

ARKATOV, V.S., chief, Main Administration for Signals and Communications, Railroad Ministry, candidate of technical sciences; KAPITONENKO, N.G., deputy chief, Leningrad Electrical Plant, Railroad Ministry, candidate of technical sciences; and POPOV, V.G., head of Leningrad Department, Central Staff, Railroad Ministry

[Abstract] A standardized system for automatic blocking (USA) has been created, which considers the operation of the integrated train traffic

regulation systems of the USSR and other nations. In the standardized system, problems of train safety have been solved at a basically new and higher technical level. The new and highly reliable type REL miniaturized relays are used in the system. All system elements operate under static conditions, with a mean time between failures of 5 to 10 years. Unreliable elements such as electrolytic capacitors and temperature sensing relays have been eliminated. The system includes track and station devices for transmission and decoding of 25 Hz code signals, line circuits and trackside signals. Movement of trains following each other is regulated by transmitting information on the status of the two-block sections ahead of each train, both to trackside signals and to automatic signalling devices in the locomotive cabs. Operation of the system is briefly and generally described. The system has been in experimental operation since February of 1983 on the southern Urals line. Experience has shown that it operates reliably.
Figures 1.
[297-6508]

INSTRUMENTATION AND MEASUREMENTS

CALIBRATION OF PHOTON RADIATION DOSIMETERS IN EQUIVALENT DOSE UNITS

BREGADZE, Yu.I., DOMAS', I.N., MASLYAYEV, P.F. and SIL'CHENKO, A.P.

[Abstract] A study is made of one stage in the development of methods and equipment for equivalent dose measurement of photon radiation. The stage in question involves measurement of the distribution of absorbed doses of photon radiation in a phantom for cobalt and cesium gamma radiation sources and x-radiation sources with various effective energies. The detector used is an ionization chamber, a plane-parallel air chamber made of a tissue equivalent substance. Absorbed doses were measured at depths of 70 μm, 3 and 10 mm in the phantom. These results were used in order to determine the variation of $K(E_{ef})$, the ratio of absorbed dose power in the phantom to the exposure dose measured outside the phantom, as a function of photon radiation energy. The curves of dose are shaped by a number of factors relating to the interaction of the radiation and the matter of the phantom: attenuation by absorption, accumulation caused by scattering and the absence of electron equilibrium at shallow depths in the phantom. Recalibration of individual dosimeters can be performed by either of two methods: 1) Placement of a tissue equivalent phantom in a directed field of photon radiation with known energy and determination of the equivalent dose at a selected point i in the phantom; and 2) Establishment of equivalent dose by measurement in a directed field of photon radiation without a phantom present, under conditions such that it can be related to the center of a sphere with radius equal to the depth of a point in the human body for which the equivalent dose must be measured. The required equations for the two methods are presented. Figures 2; tables 1; references 5: 4 Russian, 1 Western.
[296-6508]

DIGITAL RANDOM SIGNAL MEAN POWER METER

MIRSKIY, G.Ya. and KLIMOVICH, S.U.

[Abstract] A new mean power meter having the advantages of both digital
and analog devices is studied. A schematic diagram is presented, as well
as an equation which describes the principle of measurement implemented
in the device. The device is said to be more accurate than analog devices,
with a significantly wider dynamic input level range, a result of the word
length of the first analog-digital converter, and its stable electrical
characteristics under operating conditions. At the same time, the first ADC
and the digital-analog square law converter perform the same function as an
analog square law converter, but the square law is reproduced with high
accuracy over a wide range of input levels. Calculations show that for
$\Delta f=3.1$ KHz, averaging interval 1 minute, the static error is not over 1%.
The total mean power measurement error (both instrumental and statistical)
is less than 4%. Figures 2; references: 6 Russian.
[296-6508]

LOW-FREQUENCY FLUCTUATIONS IN GYROTRON CAUSED BY THERMAL NOISE

YERGAKOV, V.S., MOISEYEV, M.A. and SHAPOSHNIKOV, A.A.

[Abstract] Both shot noise and thermal noise cause low-frequency fluctua-
tions in a gyrotron (vibrating gyro; gyrotron is company name). Here the
spectral density of fluctuations caused by thermal noise is evaluated for a
gyrotron operating at fundamental cyclotron resonance. The corresponding
equations of motion for electrons, with conventional constraints according
to the theory of masers, are solved numerically by the Humming method. The
gyrotron oscillator is assumed to have a high-Q resonator so that the latter
can be replaced with an equivalent larger one containing a current-filled
surface layer of the metal wall, and the alternating current along the
resonator axis is assumed to have a Gaussian distribution. The stiffness p of
limit cycles and the nonisosynchronism parameter q, as well as the spectral
density of fluctuations, are calculated through simultaneous numerical inte-
gration of those equations of motion and the equations for electronic
susceptibility and its derivatives, this being necessary because both p and
q depend on the resonator Q-factor as well as on three other dimensionless
parameters; I proportional to the electron beam current, μ proportional to

the resonator length, and Δ proportional to the frequency deviation $(\omega_0-\omega_H)/\omega_0$ (ω_0- oscillation frequency, ω_H- relativistic cyclotron frequency of electrons). The results yield the width of the gyrotron line attributable to thermal currents in the load and in the resonator wall, this width being proportional to the resonator bandwidth squared and to the spectral density of thermal noise power but inversely proportional to the output power. Minimum line width (gyrotron operating as isochronous oscillator) is attained at values of the parameters I, μ, Δ other than their optimum ones corresponding to maximum gyrotron efficiency. Figures 5; references: 11 Russian.
[298-2415]

OPTICAL METHOD OF TESTING DIAMETERS OF PRODUCTS WITH THE USE OF PHOTOSENSITIVE RASTER GRID

KOZLOV, V.V.

[Abstract] The commonly used method of testing the diameters of cylindrical products involves scanning a beam of light over the product in order to produce a shadow, then measuring the time required for the scanning beam to pass the product, during which time it does not strike a target behind the product. A new method of testing the diameters of products has now been developed which permits testing with the product static or moving as it passes through the test device. The device consists of a laser, a tilted mirror on the axis of an electric motor, a cylindrical lens, and a special photo-converter and electronic unit used to process the results of measurement. The mirror, mounted on the end of a motor shaft, causes the beam to scan past the product whose diameter is being measured, through the half-cylinder lens, after which it strikes a raster screen. The test method involves counting the number of slots struck by light as the beam scans past the product. Because the method is based on counting pulses carrying information on the dimensions of the product, movement of the axis of the product does not influence the test results. The advantages of the method include the fact: 1) That it is not necessary to align the product and the slots of the converter critically; 2) Its high accuracy and productivity; and 3) that it is unnecessary to stabilize the rotating speed of the electric motor. Figures 2; tables 1.
[296-6508]

ANALOG MODELING OF MICROSTRIP LINES AND MICROWAVE INTEGRATED CIRCUITS

SOVETOV, N.M., KAZAKOV, G.T. and KAZAKOVA, N.I.

[Abstract] Computer-aided design of microstrip lines and microwave integrated circuits requires consideration of the entire system rather than optimization of interconnecting segments only. The system approach is demonstrated here on a microwave circuit in the form of a long transmission line with varying parameters. The one-wave approximation, used in calculations with matrices and graphs, is applied to the system of Maxwell equations for any circuit operating most often with a TEM-mode. These equations are formulated in terms of admittance components rather than voltages and currents, for solution and convenient circuit performance analysis by the analog method. Individual circuit elements are regarded as inhomogeneities in the line and are represented as lumped conductances and susceptances, for expedient evaluation by the digital method. In such a system design it is thus possible to combine analog and digital computer techniques to the best advantage of each. Figures 1; references 4: 3 Russian, 1 Western.
[291-2415]

COUPLED RELIEF-STRUCTURE MICROSTRIP LINES

SHLEYE, V.R., YEFIMENKO, A.V. and VORONIN, M.Ya.

[Abstract] The design of coupled microstrip lines with relief structure is treated on the basis of various possible realization models. In all four of them shown here two conductors in the form of flat or angle bars lie symmetrically on a dielectric substrate inside a shield of rectangular cross

section. Strong or weak coupling between the conductors is attained by variously spacing them and variously shaping the metallized groove which separates them. An algorithm of design calculations is constructed on the assumption that in the case of geometrical dimensions (substrate thickness, conductor widths) much smaller than the wavelength (smaller than $0.15\lambda_0$) the longitudinal components of the electromagnetic field appearing as a result of a nonuniform dielectric filler profile and intricate boundaries between conductors and dielectric become negligible. The cross section of the microstrip line is subdivided into regions, for each of which the Laplace equation is solved by the method of finite-difference grids. Maximum economy of calculations is achieved by maximum use of a priori available information about the microstrip line to be designed, an important consideration being that in a coupled line the potential gradient decreases with increasing distance from a conductor. The potential distribution is calculated accordingly, by the method of mirror images and superposition, with a uniform rectangular grid for one half of the symmetric cross section and with the conductor region as well as any other subregion, if necessary, treated separately. The algorithm has been programmed in FORTRAN-4. Typical design calculations reveal that, as the vertical conductor width in increased with the horizontal conductor width and the groove width remaining fixed, the coupling coefficient first increases to a maximum and then decreases with the parameters of the shield base eventually influencing this trend. As the groove width is decreased with the conductor widths remaining fixed, the coupling coefficient will increase sharply. Figures 5; references 15: 13 Russian, 2 Western.
[291-2415]

ELECTRON OSCILLATOR WITH OPEN RESONATOR: REVIEW OF THEORETICAL AND EXPERIMENTAL STUDIES

VAYNSHTEYN, L.A., ISAYEV, V.A. and TRUBETSKOV, D.I.

[Abstract] Conditions of resonance in a microwave electron device have been applied to interaction of an electron beam and electromagnetic field in an O-type device with open resonator. The corresponding fundamental relations for this orotron lead to a self-adjoint system of equations of resonator excitation $\xi=LI$ and of current (motion) $I=M\xi$ bunched in the resonance field ξ (L,M – differential or integral operators). The latter equation is explicated differently in the linear theory for analysis of the starting performance and in the nonlinear theory for analysis of the running performance. The resonance field is usually assumed to have a Gaussian distribution, with negligible losses and is thus of special practical interest. The energy characteristics, particularly the efficiency, have been calculated from the fundamental equations by numerical methods. Attention has also been paid to electron hysteresis and transient processes. Experimental results obtained so far include the dependence of the starting current on the wavelength of

generated oscillations and on the intensity of the focusing magnetic field, and the dependence of the output power on the oscillation frequency, measured at various intensities of the magnetic field in the d.c. mode of operation. Various attempts are being made to modify the orotron so as to improve its performance characteristics, the basic approach being to reduce the starting current and thus increase the running efficiency. Interaction of the electron beam with the backward wave and hybrid interaction have been considered, also various design configurations such as a coaxial orotron and a relativistic orotron. The authors thank F.S. Rusin for discussion and helpful comments. Figures 15; tables 1; references 70: 65 Russian, 5 Western.
[298-2415]

NUMERICAL ANALYSIS OF SLOT LINE AND MICROSTRIP-SLOT LINE

FËDOROV, A.N., LËVINA, N.N. and KHAMETOVA, N.A.

[Abstract] The propagation of natural modes in an elemental slot line and in a compound microstrip-slot line has been analyzed on the basis of their dispersion characteristics, by a numerical method involving the use of Chebyshev polynomials. The results for a single slot line reveal a short-wave cutoff of all modes, and that fundamental and higher-order modes depend differently on the slot width. The results for a microstrip-slot line reveal two modes without long-wave cutoff, and higher-order modes generated either by current variations in the microstrip component or by field variations in the slot component of such a waveguide. Another configuration of interest is an array of microstrip lines coupled through a slot. Here the results of numerical analysis for this case reveal three fundamental natural modes (microstrip-type with even distribution of fundamental current component I_z over the microstrips and slot-type with even distribution of field component E_x over the slot), the short-wave cutoff of each being determined by micro-strip and slot dimensions and all higher-order modes having a long-wave cutoff. The authors thank V.V. Nikol'skiy for helpful comments and dis-cussion of the results in the course of this study. Figures 10; references 9: 6 Russian, 3 Western.
[298-2415]

POWER ENGINEERING

REPAIR OF IMPORTED ELECTRIC MOTORS OF SIZES UP TO 100 kW

GESKIN, A.I., candidate of technical sciences, VLASENKO, N.P., engineer, AKININ, G.I., engineer, and KOROKHOVA, S.M., engineer, All-Union Scientific Research Institute of Electrical Explosion-proof and Mining Equipment

[Abstract] Explosion-proof electric motors in sizes up to 100 kW are now imported by various enterprises from Western European countries, Japan, and the GDR without repair instructions. Consequently, an in situ analysis was made of this motor stock in over 100 enterprises of the USSR Ministries of the Chemical and Petrochemical Industries. The survey revealed a wide assortment of motor classes and types. Documentation has been developed for the most efficient and least time consuming high-quality repair, especially of damages in the explosion-protective housing. Because the insulating wall tube and the input leads are the most vulnerable, four standard leads each in a select size have been developed and included in the repair kit. Repairs are done only in enterprises authorized to handle explosion-proof electrical equipment. Tables 3; references 5: 2 Russian, 3 Western.
[293-2415]

POWER MODULES PRODUCED IN GDR

OSTROVSKIY, A.S., engineer

[Abstract] A new series K-0360,1,2,3 of d.c. stabilized-voltage power supplies has been put on the market by the GDR "Robotron" combine in 1981. It covers a set of standard modules with which any of the power supplies, main or auxiliary, can be assembled. They include 25, 50, 100, 150 W supply modules STM, supplementary supply components STZ, a distribution box SKE and a line

filter NFI. The power supplies all operate from a $220^{+10\%}_{-15\%}$ V — 47–63 Hz line at ambient temperatures from −5 to +60°C without forced cooling under full load. The efficiency of the smallest in the series if 50%, and of the other three 75%. Another modular series of power supplies, for logic circuits, operational amplifiers, and transistor devices, is produced in Switzerland. It includes a CD (d.c. input − d.c. output), a CL (d.c. or a.c. input − d.c. output), an HF (a.c. input − regulated d.c. output), an NI (d.c. input − a.c. output), a PICOPAC (a.c. input − d.c. output), and PC-80, MC-65, PM-95, F-115 (a.c. input − regulated d.c. output). Tables 2.
[293-2415]

ACOUSTOOPTIC LIGHT-TO-SIGNAL CONVERTER USING TeO$_2$ CRYSTAL

BALAKSHIY, V.I., MOSKALEV, V.M., TORGOVKIN, M.Yu. and UPASENA, Kh.A.

[Abstract] A new type of light-to-signal converter has been developed on the basis of interaction of light and an acoustic wave. Theoretically such an acoustooptic converter is capable of scanning images in accordance with standard television requirements or better. It consists of a cell mounted between a piezo-ceramic transducer which generates a short traveling ultrasonic wave train and an absorber which controls that wave train. A lens before the cell forms the image of an object directly in the plane of this cell, the light passing through the cell being diffracted by that wave train. A lens behind the cell collects the diffracted light rays on the photoreceiver surface, nondiffracted rays being stopped by a shield. A crystal of paratellurite (TeO$_2$) with a standard cut has been found to be most suitable for the acoustooptic cell, an acoustic shear wave being excited here in the [110] direction by light propagating at the Bragg angle near the optical axis. It was tested with a piezoceramic transducer, an LiNbO$_3$ crystal with 1.5x.1.5 mm^2 cross section and a resonance frequency of 45 MHz. A scanning rate 50% above the television standard was attained, with a transient period based on 0.1/0.9 levels not exceeding 0.11 microsecond and thus a resolution of 580 elements in a sweep line at an aperture of 3.9 cm. Figures 2; references: 3 Russian.
[294-2415]

FEASIBILITY OF INCREASING Q-FACTOR OF SURFACE-ACOUSTIC-WAVE RESONATORS BY CHANGING TO INTERDIGITAL REFLECTORS WITH PARABOLIC ELECTRODES

GUREVICH, G.L., NEFEDOV, I.N. and SANDLER, M.S.

[Abstract] The basic characteristics of SAW resonators with interdigital reflectors which use parabolically bent electrodes are theoretically analyzed. A resonator is considered which consists of two identical reflectors of given length and a given distance apart, both under identical admittance loads. The interaction of acoustic wave and electric field at the load, with attendant attenuation and reflection, is described in terms of the apodization function with the aperture as the other parameter. Generally two reflection mechanisms operate simultaneously: the nonlocal mechanism with the transverse structure of the reflected wave independent of that of the incident wave and dependent only on the reflector structure (curvature of the electrodes), and the local mechanism at each electrode with the transverse structure of the reflected wave determined by that of the incident wave. The corresponding equation is first solved for two special cases, with either one or the other mechanism assumed to be negligible respectively. The case of a negligible local mechanism includes a confocal resonator with infinite aperture. A merely qualitative evaluation of a real resonator with both reflection mechanisms and comparison with one having straight electrodes reveal how curving the electrodes decreases the diffraction losses and that the losses in any specific mode can be controlled with the electrical load. Figures 3; references 6: 4 Russian, 2 Western.
[298-2415]

THEORY OF ACOUSTOOPTICAL INTERACTION IN ACTIVE RESONATORS

GULYAYEV, Yu.V. and SHKERDIN, G.N.

[Abstract] The theory of acoustooptical interaction in active media of laser resonators, with distributed acoustic feedback and amplification of electromagnetic radiation energy, is applied to the situation where diffraction of the external electromagnetic wave occurs and the field distribution in the diffraction orders approaches the field distribution in natural resonator modes. For specificity, a crystal is considered through which an acoustic wave with given wave vector $q \parallel OX$ and frequency Ω propagates while an electromagnetic wave with wave vector k in the XOY plane and with frequency $\omega \gg \Omega$

impinges on its y= 0 face. The corresponding expressions for the electric
field components in reflected and transmitted waves are evaluated not only
for this extreme case of highly efficient acoustooptical interaction owing
to resonance but also for the other extreme case of inefficient acousto-
optical interaction owing to departure from Bragg synchronism. In the former
case the intensity of diffracted radiation increases sharply near resonance
conditions, because the beam path through the interaction space becomes
effectively longer and correspondingly the small parameter is now absent in
the expressions for the electric field components. The theoretical conclu-
sions are illustrated with practical data pertaining to a GaAs crystal of
dimension d~0.1 cm becoming active when pumped at $\lambda \lesssim 0.9 \mu$m wavelengths.
References 9: 5 Russian, 4 Western (1 in Russian translation).
[298-2415]

MEASUREMENT OF SEMICONDUCTOR INJECTION LASER DIODE RADIATION PULSE LENGTH

GEMBITSKIY, S.L. and SURODIN, M.P.

[Abstract] A study is made of the space-time dependence of the parameters
of GaAs laser optical pulses. The dependence is manifested by the fact that
with constant amplitude and pulse length of injection current, the length of
the optical pulses measured at various points in the cross section of the
radiated beam is different. Preliminary measurements have shown that the
change in radiated pulse length over the cross section of the beam may be
as great as ±15%. Injection lasers with a maximum radiated pulse power of
4-10 W were studied on an experimental installation. Measurements were made
both close to the laser and at a distance of 120 cm from it. It was found
that the variation in pulse length can be reduced by using the highest possible
laser diode current, using low-threshold laser diodes, minimizing the length
of the leading and trailing edges of the pumping pulses and using laser diodes
with uniform near field index. Figures 3; references: 5 Russian.
[296-6058]

ANALYSIS OF PHASE CONVERSION ERRORS IN LASER AUTOMATIC REFRACTOMETER

MISHCHENKO, Yu.V.

[Abstract] A history of the development of laser automatic refractometers
is presented. Further increases in the accuracy of measurement of these

devices will be possible only by careful analysis of the phase conversion errors and optimization of optical path parameters. This is the task of the present article. Equations are derived which can be used to calculate the basic parameters of the optical path of a laser automatic refractometer. The analysis of phase conversion errors thus allows well-founded selection of the basic parameters of the optical path, allowing the accuracy of measurements to be increased by a factor of 2 to 3. Figures 2; references 14: 13 Russian, 1 Western.
[296-6508]

INCREASING THE TRANSILLUMINATION CAPABILITY OF LASER BEAM IN ATMOSPHERE

GORDIN, M.P., SADOVNIKOV, V.P. and STRELKOV, G.M.

[Abstract] A laser beam is considered which propagates vertically upward through the atmosphere. The steady propagation process, described by the corresponding wave equation with heat conduction disregarded but horizontal mass transfer included, has been simulated earlier, numerically, for a collimated Gaussian beam. One way to achieve a more efficient interaction with an aqueous aerosol without changing the beam power is to increase its initial transillumination capability. This possibility has been subsequently analyzed, also numerically, using first a collimated beam with elliptical cross section (equi-intensity lines in shape of ellipses), then a focused Gaussian beam, and finally the features of both combined in a focused elliptical beam. The results of calculations for these beams propagating through a 3 km high ground layer of the atmosphere confirm the effectiveness of such beam shaping. Figures 5; references 13: 9 Russian, 4 Western.
[298-2415]

ACTION OF STRONG STRUCTURAL INTERFERENCE ON RADIO ENGINEERING SYSTEM WITH
PSEUDONOISE SIGNALS

VARAKIN, L.Ye. and VLASOV, A.V.

[Abstract] Radio engineering systems operating with pseudonoise signals,
particularly with phase-keyed signals, are sensitive to structural inter-
ference of either intrasystem or external origin. Here the action of such
interference is analyzed, not on the basis of the rms value of the cross-
correlation function, but more precisely on the basis of the distribution of
its peaks. This distribution is approximated, including the first four
moments of a random quantity. The probability distribution density of these
peaks is synthesized, using a truncated Edgeworth series for the case of a
nearly normal distribution of peak heights of a normalized periodic cross-
correlation function. The action of a strong interference is then evaluated
for two modes of system operation, first scan of pseudonoise signals and
then transmission of data. In the scan mode the action of structural inter-
ference depends largely on the statistical characteristics of the pseudonoise
signal array, particularly on the excess of cross-correlation peaks, and will
weaken as the signal base is broadened. In the transmission mode, with the
array of signals including structural interference, the action of the latter
also depends largely on the excess of cross-correlation peaks and will weaken
as this excess as well as the higher-order moments are decreased. Figures 3;
references 6: 5 Russian, 1 Western (in translation).
[291-2415]

SYNTHESIS OF ADAPTIVE TRACKING SYSTEMS

PEROV, A.I.

[Abstract] An algorithm of adaptive filtration for tracking systems is constructed which involves no indeterminacy in selection of the weight factor (such an indeterminacy being characteristic of a stochastic approximation) and does not require that the input action of a tracked process plus additive noise be given in neat form. The algorithm is a sliding and, therefore, simple one. The useful message which the tracked parameter carries is described by one term or several terms of a Markov sequence. The gain matrix is sought which will extremize the quality functional, with the noise dispersion matrix first assumed to be known and the results then extended to the case of an unknown noise dispersion matrix. The efficiency of this algorithm is evaluated for a typical model example. The gain matrix which minimizes the dispersion of extrapolation error also corresponds to the zero-crossover of the discrimination characteristic of the adaptation circuit. The final gain matrix will be generally different than the optimum matrix of Kalman filter coefficients. Figures 2; references 12: 6 Russian, 6 Western (1 in translation).
[291-2415]

EVENTS AND FACTS

Editorial Staff

[Abstract] A conference on Problems in and the Outlook for Data Transmission and Teleprocessing will be arranged at Kishinev in November 1983 by both the Central and Moldavian Republic administrations of the Scientific and Technical Society of Radio Engineering and Electrical Communications imeni A.S. Popov, jointly with the USSR Ministries of Communications, the State Committee on Science and Engineering at the USSR Council of Ministers, the USSR Ministries of Higher and Secondary Specialized Education, the USSR Academy of Sciences, and radio, electronics, communications, instrument, control and automation equipment manufacturing industries. The conference will deal not only with problems of data transmission and teleprocessing but also with problems of utilization of nation-wide EASS (Unified Automated Communication Network) channels for these purposes, problems of hardware improvement, and problems of software improvement. The Central administration of the A.S. Popov Institute jointly with the USSR Academy of Sciences, the USSR Ministries of Communications, the USSR Ministries of Higher

and Secondary Specialized Education, and all the aforementioned industries will also arrange a conference at Penza in September 1983 on Development of Data Storage Theory and Technology. This conference will deal with problems of data storage equipment utilization, with methods of increasing its speed and reliability, with data storage as important component of cybernetic systems, and with an examination of the most promising trends in further development of memory devices.
[295-2415]

TEMPERATURE STABILITY OF FREQUENCY OF SURFACE-ACOUSTIC-WAVE GENERATOR

VOKHMIN, V.P. and YAKOVKIN, I.B.

[Abstract] SAW generators do not require frequency multiplier stages for producing oscillations at decimetric wavelengths with stable frequency, but temperature stability at this frequency presents a major problem. Such a generator essentially consists of two interdigital transducers separated by a delay line and shunted by an amplifier, each component introducing a phase shift. With respect to temperature variation as a source of instability, the relative frequency change as a function of the temperature change is calculated here according to the general theory where $\Delta\omega/\omega = -\Delta T \sum_{i=1}^{n} \frac{\partial \varphi_i}{\partial \omega}$ (ω- frequency, T- temperature, φ_i- phase angle) for such a generator with n temperature and frequency sensitive circuit components. The sensitivity of phase angles to frequency change $\partial \varphi_i/\partial \omega$ as well as the holding ability of each generator component, is calculated as a function of acoustical or electrical parameters, respectively. Numerical results have been obtained for a device with a sound guide made of xyl/35.5°-cut quartz crystal as a delay line and two transducers with $w = 125\lambda$ wide aperture each, both separated by a distance of 500λ center-to-center. The holding ability of the transducers, depending on the frequency, was found to vary from $0.2 \cdot 10^{-6}$ to $-0.28 \cdot 10^{-6}$. The holding ability of the delay line (operating frequency 391.1 MHz, bandwidth 0.8 MHz, delay time 1.27 μs, insertion loss 14 dB), depending on the delay time only (scattering of surface acoustic waves in aluminized quartz plate negligible in first approximation) and determining that of the generator, was found to be $-1.07 \cdot 10^{-6}$ on the low-frequency slope and $-1.55 \cdot 10^{-6}$ on the high-frequency slope. Calculations were based on an acoustic velocity $v = 3146.3$ m/s and a wavelength $\lambda = 8$ μm. The results, confirmed experimentally, indicate that the operating frequency of an SAW generator should be selected on the high-frequency slope of the amplitude-frequency characteristic of its delay line. Figures 3; tables 1; references 4: 1 Russian, 3 Western (1 in Russian translation).
[298-2415]

EFFECT OF DIVERGENCE OF ULTRASONIC WAVES IN SOUND GUIDE OF ACOUSTIC MODULATOR ON SPACE SPECTRUM OF RADIO PULSE SIGNAL

BUKHARIN, N.A., YESEPKINA, N.A. and ROGOV, S.A.

[Abstract] An acoustooptical light modulator is considered as an input device in topical real-time data processing systems. High-density packing of channels requires that the dimensions of the piezoceramic transducers be small, but the resulting diffractional divergence of ultrasonic waves in the sound guide can then become so wide as to cause an overlap of channels. Toward a solution of this problem, the effect of the divergence on the space spectrum of the a processed radio signal is analyzed for a pulse $s(t) > 0$ ($0 \leq t \leq \tau$) exciting ultrasonic waves $0(y,t)= AP_{1/2_w}(y)s(t)$ in a transducer of width w. The ultrasonic field distribution in the sound guide and the luminous field distribution in the focal plane of the integrating lens are calculated in terms of a Fourier integral and a Fourier transform, respectively, with the complex-conjugate spectrum of the real signal s(t) already defined, and considering an interval of time $\tau < D/v$ (D- axial length of sound guide, v- velocity of ultrasonic waves in sound guide) during which the entire pulse remains contained in the sound guide. Experimental data obtained with a radio pulse of 0.6 μs duration passing through a sound guide made of TF-3 glass and with a w= 0.9-mm wide transducer confirm the theoretical relations, which thus can be useful for design purposes. Figures 3; references 7: 6 Russian, 1 Western (in Russian translation).
[298-2415]

EFFECT OF SCATTERING AND DIFFRACTION OF SURFACE ACOUSTIC WAVES ON CHARACTERISTICS OF MATCHED FILTERS FOR PHASE-KEYED SIGNALS

KOZLOV, A.S., TOLSTOUKHOV, N.I. and YAKOVKIN, I.B.

[Abstract] Propagation of SAW packets with a rectangular envelope and a uniform space period is analyzed from the standpoint of application to matched filters for phase-keyed signals. The correlation characteristics of such a filter are calculated on the basis of the phase distortion in its pulse response which results from scattering and diffraction of surface acoustic waves in its structure. The results indicate that the ratio of correlation peak amplitude to amplitude of the largest side lobe does not decrease much as long as the center-to-center distance between input and output transducers does

not exceed approximately twice the radius of the first Fresnel zone. This
small decrease can, moreover, be compensated by apodization of the output
transducer. Figures 1; references 4: 2 Russian, 2 Western (1 in Russian
translation).
[298-2415]

CONSTRAINTS ON RADIATION DIRECTIVITY DURING IMAGE TRANSMISSION

DERYUGINA, A.I., DERYUGIN, I.A. and KURASHOV, V.N.

[Abstract] Directional radiation sources for image transmission are con-
sidered, and relations between the information content in the field at the
source aperture and the divergences of the emitted radiation flux are
established on the basis of such concepts as generalized luminosity (A. Walther,
J.OSA Vol 58, No 9, 1968) and degrees of freedom (B. Saleh, J.OSA Vol 67,
No 1, 1977) as well as the concepts of classical radiometry. Analysis and
calculations yield a constraint on the degrees of freedom in the form of an
inequality between the indeterminacy of the information efficiency and the
indeterminacy of the radiation directivity, the information volume in the
field being proportional to the number of the field's effective degrees of
freedom. Furthermore, the divergence angle is found to determine the diffrac-
tional divergence of a completely coherent Gaussian light beam. Figures 1;
references 10: 3 Russian, 7 Western (2 in Russian translation).
[298-2415]

NEW EQUIPMENT MANUFACTURED BY 'VEB KOMBINAT ELEKTROENERGIEANLAGENBAU' (GDR)

[Abstract] New equipment manufactured by the VEB Kombinat Elektroenergiean-
lagenbau (GDR) includes the following items: 1) 315-1600 A branching switches
for large transformers operating in various climates; 2) a manually or auto-
matically operated "eBr 40" electronic kvar regulators for capacitor banks
with switch-on and switch-off time variable in 4, 40, 240 s steps or with
stepless preselection of kvar compensation within the $\cos\phi = 0.8-1$ range in 100
or 400 V and 1 or 5 A circuits; 3) compact 1000 and 1600 kVA distribution trans-
formers with rectangular iron core, characterized by low open-circuit and short-
circuit losses as well as low noise level, cooled with nonflammable oil; and
4) reliable small low-voltage 1000/5 current transformers V3 and D6 for instru-
ments and relays, furnished with bar conductors to suit specific applications.
[298-2415]